Sound of Science
理聲
Newsletter of Science Promotion Team
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Earthquake Prediction: Mission Impossible

"We just had an earthquake, so we're safe for a few years."
"It's earthquake weather."
"The moon and planets are lined up."
"We're may overdue."
Have you heard these statements? Maybe said them yourself? People are intensely interested in foreseeing earthquakes. Like lottery strategies, everyone has a theory—and also like lottery strategies, none of them work. After a century of close study, earthquakes look just like random events.
Do earthquakes correlate with the phase of the Moon? No they don't. Do they tend to occur during a particular type of weather? No they don't. What about time of year? No effect. Previous seismic events? Outside of aftershocks, no. Sunspots and solar cycles? Nope, nope. Not even psychics do better than chance. Every prediction method makes lucky hits, but none of them really work.
Lay people reinvent these hypotheses anyway. They ask the real experts about them every day—they even ask me—and we try to educate them.

Earthquake Prediction in the 1990s

Scientists have moved on to more sophisticated guesses, but with little more success. It doesn't matter, for instance, how long it has been since the last earthquake along a particular stretch of geologic fault. It doesn't matter what fluid pressures underground are doing—rising, falling, or fluctuating. It doesn't matter what the electrical conductivity of the ground is doing. The behavior of earthquake faults is a stubborn mystery. Seismologist Yan Kagan of UCLA said a few years ago, "It may require the development of completely new mathematical and theoretical tools. We should not expect significant progress in this direction in the near future." (That doesn't stop him from trying new schemes, though.)
A team of Greek seismologists, known as the VAN group after the names of its leaders (Panayotis Varotsos, Kessar Alexopoulos, and Kostas Nomicos of the University of Athens), has long claimed to make useful predictions from a complicated network of signal detectors in electric power lines of many kilometers length. But a dedicated group of critics has kept the VAN group on its mettle. The debate was formalized in 1996 in *Geophysical Research Letters*. The VAN group responded to each of 16 Comments with a formal Reply. In some cases the exchange continued further, a sign of strong disagreement over basic matters. These days their work seems to be ignored generally, although Seiya Uyeda continues similar research with his group in Japan.
Later that year—November 7–8 at a "discussion meeting" in London sponsored by the Royal Astronomical Society and the Joint Association for Geophysics—researchers agreed to put the whole question aside: earthquakes appear to be inherently unpredictable. Prominent seismologist Robert Geller reported on the RAS-JAG meeting in the pages of *Eos*:

The overwhelming consensus of the meeting was that earthquake prediction, in the popular sense of deterministic short-term prediction, is not possible at present. Most of the participants also agreed that the chaotic, highly nonlinear nature of the earthquake source process makes prediction an inherently unrealizable goal. . . . The mass and trade media's highly optimistic reports on prediction differ greatly from the extremely pessimistic consensus of the meeting. Participants agreed that efforts should be made to correct the media's misconceptions, but there was pessimism about the prospects for real improvement.

The word "chaotic" is significant, because the mathematics of chaos is a step forward. The pattern of earthquakes along a fault resembles other chaotic phenomena like the avalanching of a sand pile under a random rain of sand grains—while each individual occurrence is unpredictable, the bulk result can be modeled quite precisely. In the case of the sand pile, the bulk result is a cone with sides at the angle of repose. For earthquakes it is an overall level of energy release that matches the tectonic movement of the earth's plates. From that information we can confidently map the expected long-term hazards for a region—that is, we can construct long-term **forecasts**. This is vitally useful for planners, emergency agencies, and designers of buildings and other structures.
A related development was a 1996 paper from *Science*, by the all-star cast of Robert Geller, David Jackson, Yan Kagan, and Francesco Mulargia, was about as strong a statement as scientists can make on the subject, starting with its title—"Earthquakes Cannot Be Predicted."

科學專題常識問答比賽(科 CEPT)問題精選

1. 超聲波被廣泛應用於不同的範疇，除了以下哪一項?
   A. 煮食　　B. 工業　　C. 軍事　　D. 醫療

2. 每增加 10 分貝等於強度增為(1)倍，增加 20 分貝增為(2)倍，30 分貝則增為(3)倍。(1)、(2)、(3)分別為?

	(1)	(2)	(3)
A	1	2	3
B.	5	10	15
C.	10	100	1000
D.	2	4	8

3. 酸雨的成分主要有硫酸、硝酸和鹽酸 3 種，以(a)為最多，約佔 60%一 65%；(b)次之，約 30%；(c)約 5%。(a)、(b)、(c)應為:

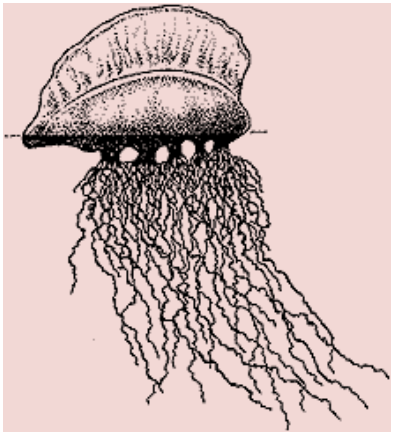
	(a)	(b)	(c)
A.	硫酸	硝酸	鹽酸
B.	硫酸	鹽酸	硝酸
C.	硝酸	硫酸	鹽酸
D.	鹽酸	硝酸	硫酸

4. 以下哪一種測量 pH 值的方法較為準確?
   A. pH 計　　B. pH 試紙　　C. 通用指示劑　　D. 紅葉捲心菜溶液

自由自在四處飄逸的水母

有一陣子，台北街頭，常有青少年提著一包塑膠袋，映著光線，側著頭，細細觀賞裡面半透明的生物。

湊過去一瞧，原來是水母。看著牠以半透明的體膜，規則地壓縮水，不斷形成反射的動作，邊緣上的觸手，隨水漂搖，加上用甲基藍染色後，相當迷人(如右下圖，市面上販售的多是這種透明的軟水母)。可惜有的只活了二十天左右，還有的一加水就死了。有些同學就問要如何養才能存活得久一點；甚至曾有立法委員以生態保育的觀點提出了質疑。



水母、海葵、水螅、珊瑚等都是腔腸動物，水母則是其中水螅綱和缽水母綱的生活史中的一段有性世代。

雌雄有別的水母，會產生卵和精子在水中受精。孵育成的幼蟲，會沈入海底棲息成水螅型的蟲體，不斷地長大萌芽發育。到了每年春、秋季，天氣變化較大時，便會以生殖芽生出水母型蟲體，變成四處漂浮、自由自在的水母體。

大部份的水母，體內百分之九十八以上是水分，所以對水中鹽度的滲透壓甚爲敏感，只要加入淡水，鹽度改變，就可能致死。若用小瓶子養，不久就可能缺氧死亡，所以沒有適當的設備，補足水中氧氣及維持固定的鹽分，不太容易養活。

水母的身體薄而透明，只由兩層細胞組成，百分之九十八以上爲水分！

在台灣沿岸，每年春、秋季，天氣一變暖，各式各樣的水母便出現在海水中，數以萬計，可說是「滿坑滿谷」，到處都是哩！筆者曾在春季時，在船上用網撈浮游生物，而撈起一滿袋的各種水母，倒在水桶中，就像是一整桶切碎的「愛玉」一樣。「水螅綱」的水母，有些是體型很小，只有鉛筆尖大小的「管水母類」，或者身體圓圓的「花水母類」、「軟水母類」、「硬水母類」及「囊泳水母類」等。市面上所賣的大部份是「軟水母類」，體呈圓弧形，下方傘緣有許多細小的觸手，直徑有一兩公方，也有像籃球那麼大的。

「缽水母綱」的水母有「立方水母類」及「旗口水母類」，體型通常較大，尤其旗口水母類的觸手多，下方的口腎厚且大。在澳洲大堡礁，曾發現直徑達一百二十公分的「金色水母」，有小孩被襲，導致死亡的紀錄！

在設備較好的水族館中，也有養這種水母的，不過都選直徑約數公分的。筆者在墾丁、花蓮的石梯坪潛水時，見過直徑達三十公分的，牠用傘狀身體噴射動作，相當漂亮。在東北角海岸也看過僧帽水母(如右上圖)、風帆水母、錢幣水母等，也蠻吸引人的。

潛水時，也會看到另一種「櫛水母動物」，與水母很像，長有兩條長長觸手的「櫛水母」，和橢圓形沒有觸手的「海神櫛水母」，會產生淡藍綠色的「生物光」，沿著體表循繞。大量出現時，波浪的掀動或者船行通過，也會刺激牠們，在水面形成一片亮光，相當奇妙。夏天到海邊休憩時，不妨細心觀察一下！

Science Quiz (科 CEPT)

Questions are posted on the notice board of Science Promotion Team near the Staff Common Room. For more details, please refer to the notice board.

Science Promotion Team 2010-2011:

Chairperson: Yang Chun Pong 楊雋邦 5D

Committee Member: Chung Lai Him 鍾禮謙 5D, Hung Ka Kiu 洪嘉僑 5D, Lee Lok Tin 李樂天 5D, Lo Wai Ki 盧偉祺 5D, Mak Chun Wing 麥駿穎 5D, Lo Lai Fong 盧麗芳 5E & Yip Tsz Fung 葉子楓 5E

Website: http://210.3.43.253/~lck/science/spt1011/spt1011.htm

科學專題常識問答比賽(科 CEPT)問題精選答案

1. A. 煮食 (在工業上，常用超聲波來清洗精密零件。軍事上，潛艇用聲吶來發現敵軍的艦船與潛艇。在醫療上，可以利用超聲波進行洗牙和超聲波碎膽結石等等應用。)
2. C. (分貝的標準設定,是根據聽力正常的人所能聽到的最小聲音而釐定的。 每增加 10 分貝等於強度增為 10 倍,增加 20 分貝增為 100 倍,30 分貝則增為 1000 倍。)
3. A. 酸雨的成分主要有硫酸、硝酸和鹽酸 3 種，以硫酸為最多，約佔 60%－65%；硝酸次之，約 30%；鹽酸約 5%，此外還有有機酸約 2%左右。
4. A. pH 計，pH 計是一種用於測量液體的 pH 值（有時使用特殊的探針測量半固體物質）的電子儀器。一個典型的 pH 計由一個特殊的測量探頭連接到電子式電能表並顯示 pH 讀數。

Our yearly whole school science competition (20 to gather 易發易拾) was successfully held on 4th March, 2011.

Thank you for your participation!

Winners

Champion: Cheng Chun Shing (6S)

1st Runner Up: Lim Kam Ho (5E) & Li Wing Sze (5A)

2nd Runner Up: Tau Tsz Him (4E)

The Best Creativity Award: Lim Kam Ho (5E) & Li Wing Sze (5A)

The Best Appearance Award: So Ka Leung (3D), Lo Sze Yan (2B) & Wan Chi Yeung (2A)